Space Weather Technical Forecast

Issued on Friday, 03 November 2023 at 01:11 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further M-class flares likely throughout. Active fluence expected today.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with a peak flare of M1.6 at 02/1222 UTC from AR3474, with also a M1.0 flare at 02/1921 from an unnumbered region that is now rotating onto the visible disc over the southeast limb. AR3474 in the southwest remains the largest and most magnetically complex region currently visible, but has exhibited some slight decay and separation of the large trailing spot during the period, whilst the penumbra on the lead spot has simplified to become symmetric. The new region rotating onto the southeast limb is likely to emerge as a significant large region, probably overtaking AR3474 in terms of size and magnetic complexity.
A filament eruption was detected around 02/0230 UTC from a region close to AR3479 in the northeast, and an associated CME has now has been modelled to not have any Earth-directed component. No other potentially Earth-directed CME's have been apparent in available imagery.

Solar Wind / Geomagnetic Activity: Solar wind speeds observed at L1 by ACE continue to steadily decline, as the previous high speed stream from coronal hole 66 ceases. Solar wind speeds reduced from slightly elevated levels of 440km/s to background levels around 370km/s during the period. Density has persisted at below average values. The total magnetic field strength, Bt, has been persistently weak, with the north-south component, Bz, also varying weakly. Phi angle was predominantly positive (away from the Sun). Geomagnetic activity was Quiet (Kp 1-2) throughout.

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels. GOES16 high energy (greater than 2MeV) electron flux was at High levels between 02/0925-2225 UTC, with a peak of 2380 pfu at 02/1525 UTC. The associated 24-hour fluence exceeded the Active (1e8 integrated pfu) threshold at 02/1200 UTC, with 1.11e8 integrated pfu recorded at 03/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate solar activity is expected, with further isolated M-class flares likely.

Solar Wind / Geomagnetic Activity: A CME that left the Sun late on 31 Oct may give Earth a glancing blow either late tomorrow (04 Nov) or early day 3 (05 Nov). No other potential CME's are expected during the period, and also no coronal hole influence. Geomagnetic activity is expected to be mostly Quiet (Kp 0-1), with a chance of isolated Unsettled (Kp 3) intervals. However, any potential arrival of the CME from 31 Oct could see activity increase to Active (Kp 4) levels, with a slight chance of G1/Minor geomagnetic storm (Kp 5) intervals, late tomorrow (04 Nov) or early day 3 (05 Nov).

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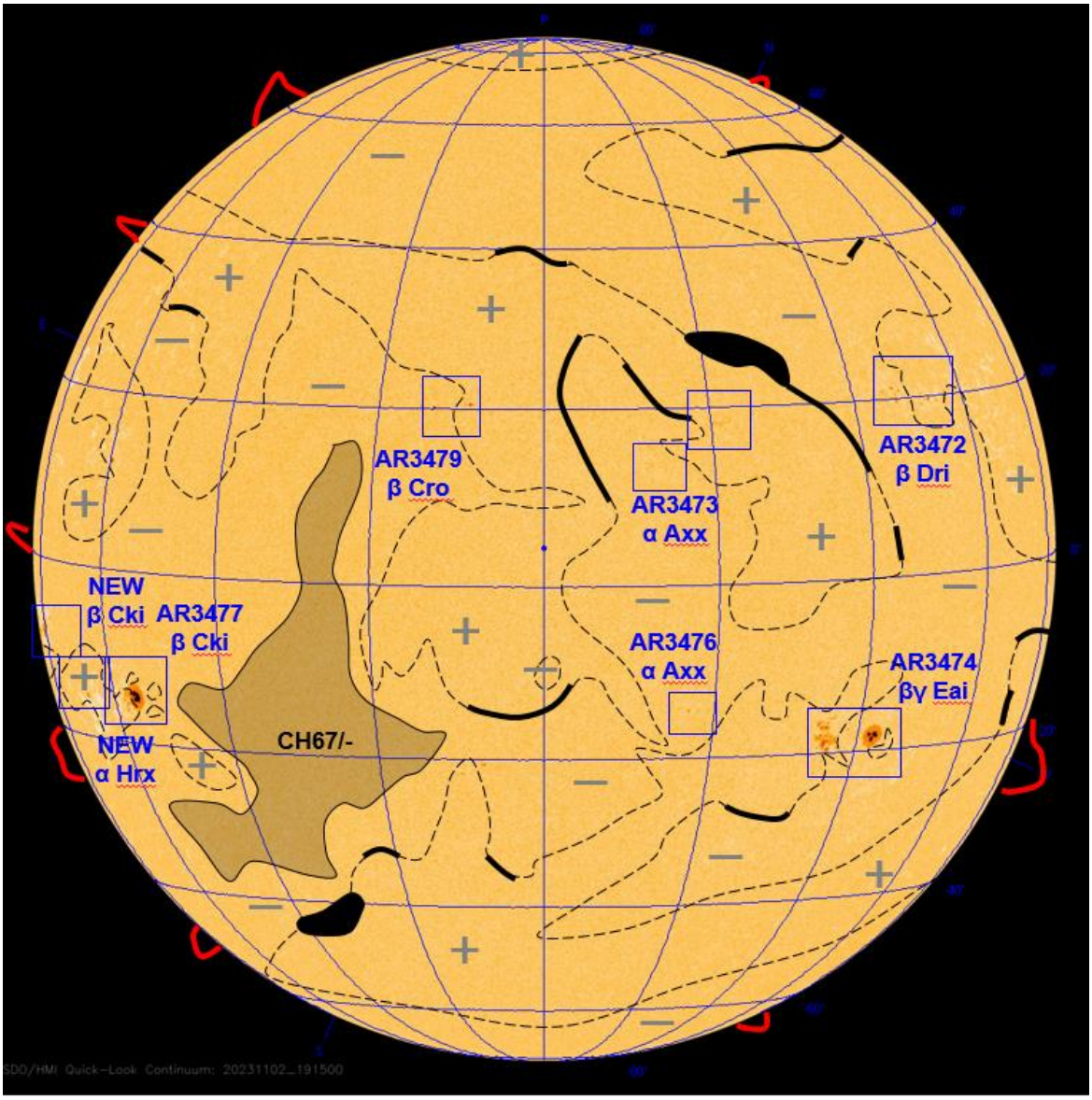
Met Office Space Weather Technical Forecast

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to persist at background levels. High energy electron flux (greater than 2MeV) is forecast to oscillate between mainly Moderate and High levels today and tomorrow, but with a decreasing day-on-day peak, then ending the period at background to moderate levels. Electron fluence values are now just above the Active (greater than 1e8 integrated pfu) threshold and is expected to remain above this level today (03 Nov), with a declining trend thereafter.

Figure 1. Solar Analysis Valid 02/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A filament eruption from the southeast disc around 31/2200 UTC resulted in a CME that may give Earth a glancing blow either late tomorrow (04 Nov) or early day 3 (05 Nov). A second filament eruption was detected around 02/0230 UTC from a region close to AR3479 in the northeast, but has been modelled as missing Earth.

Solar wind speeds have declined to around 370km/s as the effects of the previous high speed stream from CH66/+ cease. No significant coronal holes are forecast to connect with Earth within the forecast period, and therefore predominantly background level wind speeds are expected, ignoring influence from the potential CME arrival.

Mainly Quiet geomagnetic activity is expected with a chance of isolated Unsettled intervals. Any arrival of the CME from late 31 Oct during the latter part of day 3 (04 Nov) or early day 4 (05 Nov) could see activity increase to Unsettled to Active levels.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	20	20	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
01/0410	Partial	Filament	SE	628 km/s	04/2300UTC	Low confidence glancing blow

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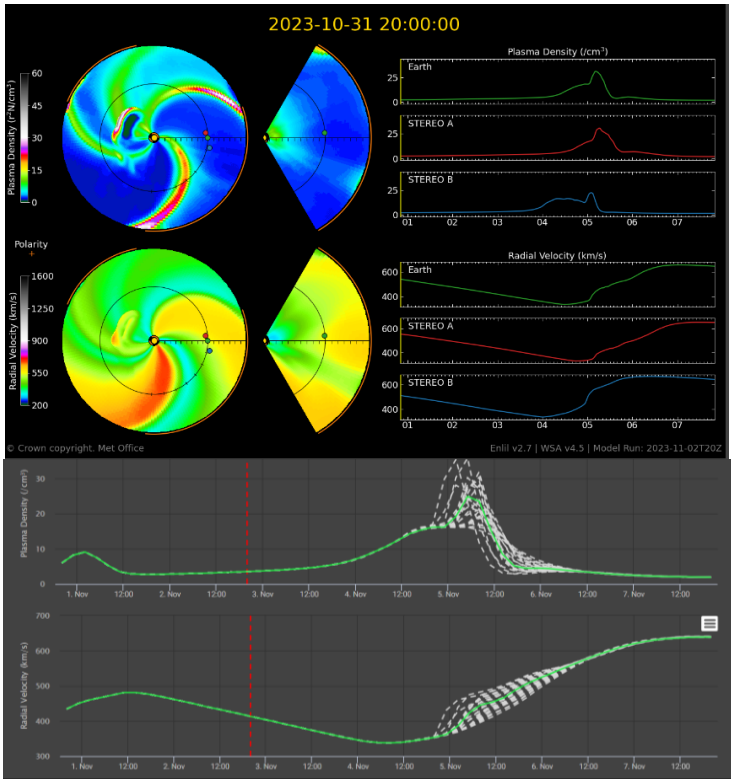
Figure 2: Met Office ENLIL forecast and ENLIL ensemble forecast, showing the potential CME arrival.



Radio Blackouts - X-Ray Flares:

There are seven numbered sunspots on the visible disc. Of these regions AR3474 remains the largest group and most magnetically complex, and is now classified as Dho/beta-gamma with the lead spot's penumbra becoming symmetric. Most intermediate spots have faded, while the trailing spots have gained penumbra, and therefore overall the area AR3474 has not changed. The region was responsible for an impulsive M1.6 flare at 02/1222 UTC. Most other regions are stable or in slow decay, although AR3477 is now classified as Cki/beta with the main penumbra becoming asymmetric. AR3479 has shown a slight increase, becoming Cro/beta.
The most significant change on the visible disc is the arrival of a new region onto the southeast limb. This region is currently classified as Cki/beta but as it rotates further onto the disc it is likely to emerge as a large and magnetically complex region, probably overtaking AR3474.
Low to Moderate activity is expected to continue with further isolated M-class flares likely, these most likely from AR3473, AR3474 or the new region on the southeast limb.

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X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	50	50	50	50
Very Active	R3 to R5 X Class	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is expected to persist at background levels, although there is a very slight chance of proton storms from AR3474 as it is currently in a favourable location, in the western hemisphere of the visible disc.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is expected to continue to vary between Moderate and High levels initially. A gradual day-on-day decrease in diurnal maxima is probable during the period, as the influence of the previous HSS from CH66 declines, with more persistently background or Moderate levels likely for days 3 and 4 (5th and 6th).

Electron fluence has exceeded the Active (greater than 1e8 integrated pfu) threshold and is expected to remain above this level today (03 Nov), with a declining trend from tomorrow onwards. The MOSWOC REFM model is therefore considered to be offering good guidance regarding the trend of the fluence, although the model is currently underestimating the fluence.

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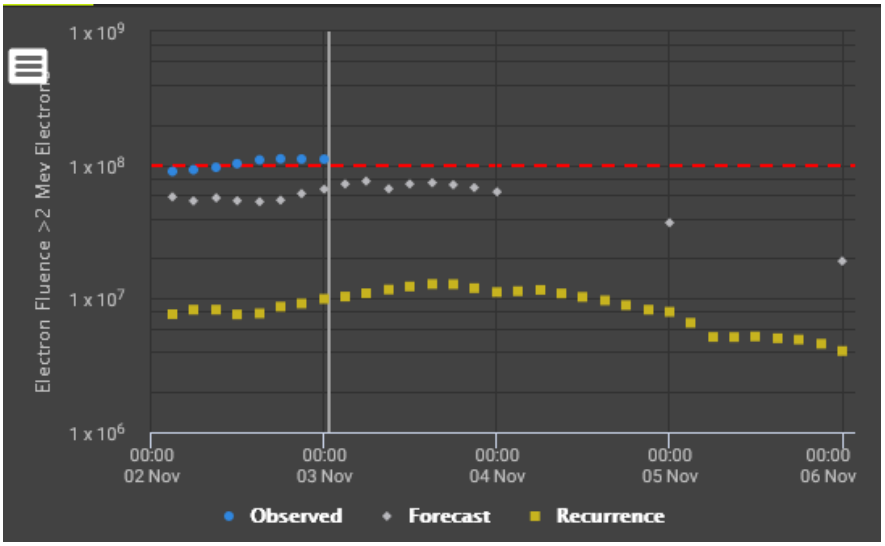
GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	100	80	40	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: Met Office REFM model.



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